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U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER
8830-27

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO.
(If known, see 37 C.F.R. 1.5)
10/069649

EXPRESS MAIL NO. EL 931089682 US

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/GB00/03273	**25 August 2000**	**26 August 1999**

TITLE OF INVENTION: **HEAT TRANSFER DEVICES**

APPLICANT(S) FOR DO/EO/US: **Aws Nashef; Ted Vander Wiede, ; Robert McNair; Stephen Wilson; and Simon Andrews**

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. _X_ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.

2. ___ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.

3. _X_ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371 (b) and PCT Articles 22 and 39(1).

4. _X_ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. _X_ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ___ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. _X_ has been transmitted by the International Bureau (as noted in PCT/IB/308).
   c. ___ is not required, as the application was filed in the United States Receiving Office (RO/US).

6. ___ A translation of the International Application into English (35 U.S.C. 371(c)(2)).

7. _X_ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. __ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. __ have been transmitted by the International Bureau.
   c. __ have not been made; however, the time limit for making such amendments has NOT expired
   d. _X_ have not been made and will not be made.

8. _X_ Amendments to the claims of the International Application under PCT Article 34.
   a. __ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. __ have been transmitted by the International Bureau (as noted in PCT/IPEA/416).
   c. __ have not been made; however, the time limit for making such amendments has NOT expired.
   d. _X_ have not been made and will not be made.

9. ___ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).

10. _X_ A copy of the unsigned oath or declaration of the inventors. (35 U.S.C. 371 (c)(4)).

11. ___ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 12. to 16. below concern other document(s) or information included:

12. _X_ An information Disclosure Statement under 37 CFR 1.97 and 1.98.

13. ___ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

14. _X_ A FIRST preliminary amendment.
    ___ A SECOND or SUBSEQUENT preliminary amendment.

15. ___ A substitute specification.

16. ___ A change of power of attorney and/or address letter.

17. _X_ Other items or information:
    Certificate of Express Mailing Under 37 CFR 1.10
    Courtesy Copy of Publication PCT/GB00/03273

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U.S. APPLICATION NO. (If Known, see 37 C.F.R. 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER:
10/069649	PCT/GB00/03273	8830-27

18. X The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (27 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO $890.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482)		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)		
ENTER APPROPRIATE BASIC FEE AMOUNT =	**$ 890.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than __ 20 X 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	**$ 130.00**	

Claims	Number Filed	Number Extra	Rate		
Total Claims	28 - 20 =	8	x $18.00	**$ 144.00**	
Independent Claims	2 - 3 =	0	x $84.00	**$**	
Multiple dependent claim(s) (if applicable)			+ $280.00	**$**	
TOTAL OF ABOVE CALCULATIONS =				**$ 1164.00**	
Reduction by 1/2 for filing by small entity, applicable. Applicant is a Small Entity.				**$**	
SUBTOTAL =				**$ 1164.00**	
Processing fee of **$130.00** for furnishing the English translation later than __ 20 __ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				**$**	
TOTAL NATIONAL FEE =				**$ 1164.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				**$**	
TOTAL FEES ENCLOSED =				**$ 1164.00**	
				Amount to be refunded	**$**
				Amount to be charged	**$ 1164.00**

a. X A check in the amount of **$ 1164.00** to cover the above fees is enclosed.

b. ___ Please charge my Deposit Account No. _____ in the amount of $___ to cover the above fee. A duplicate copy of this sheet is enclosed.

c. X The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **500573**. A duplicate of this sheet is enclosed.

SEND ALL CORRESPONDENCE TO:
Robert E. Cannuscio
DRINKER BIDDLE & REATH LLP **(Customer Number 23973)**
One Logan Square
18th & Cherry Streets
Philadelphia, Pennsylvania 19103-6996
United States of America

23973
PATENT TRADEMARK OFFICE

SIGNATURE
Robert E. Cannuscio
NAME
36,469
REGISTRATION NUMBER

PATENT

Attorney Docket No.: 8830-27

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re:	Patent application of Nashef, Aws, et al.	:	International Application No.: PCT/GB00/03273
		:	International Filing Date: 25 August 2000
Serial No.:	Not Yet Assigned	:	Group Art Unit:
Filed:	Herewith	:	Not Yet Assigned
For:	HEAT TRANSFER DEVICES	:	Examiner: Not Yet Assigned

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to examination of this application and before calculation of the filing fee, please amend the application, without prejudice, in accordance with the following.

Charge any fee or credit any overage associated with this preliminary amendment or the application filing to Deposit Account No. 500573.

CERTIFICATE OF MAILING UNDER 37 C.F.R. 1.10

EXPRESS MAIL Mailing Label Number: EL 931089682 US
Date of Deposit: February 26, 2002

I hereby certify that this correspondence, along with any paper referred to as being attached or enclosed, and/or fee, is being deposited with the United States Postal Service, "EXPRESS MAIL–POST OFFICE TO ADDRESSEE" service under 37 CFR 1.10, on the date indicated above, and addressed to: Commissioner for Patents, Washington, D.C. 20231.

Therese McKinley
Signature of person mailing page:

THERESE McKINLEY
Type or print name of person

AMENDMENTS

Please amend the application as follows, without prejudice.

In the Claims (Clean Copy):

1. (Amended) A catheter having a distal end and a wall, the catheter comprising a heat transfer device located approximately at its distal end, wherein the heat transfer device is engaged with the catheter wall.

2. (Amended) A catheter as claimed in Claim 1 wherein the heat transfer device is a flexible film having at least one electrical resistor flow path, which film is locatable around the catheter wall.

3. (Amended) A catheter as claimed in Claim 2 wherein the film is a flexible metal film on which the at least one electrical path has been formed.

4. (Amended) A catheter as claimed in Claim 2 wherein the at least one electrical path is located on a plastic film backing.

5. (Amended) A catheter as claimed in Claim 4 wherein the at least one electrical path is added by a deposition process.

6. (Amended) A catheter as claimed in Claim 4 wherein the at least one electrical path is added by a coating process.

11. (Amended) A catheter as claimed in Claim 10 wherein the printing process uses a conductive medium, with subsequent etching.

12. (Amended) A catheter as claimed in Claim 7 wherein a temperature sensor material is also disposed onto the catheter wall by a deposition process.

13. (Amended) A catheter as claimed in Claim 1 wherein the heat transfer device includes at least one sensing element.

14. (Amended) A catheter as claimed Claim 1 wherein at least one insulator layer is located over the resistor structure.

15. (Amended) A catheter as claimed in Claim 14 wherein the at least one insulator layer is made from parylene C.

16. (Amended) A catheter as claimed in Claim 1 wherein the heat transfer device an outwardly located layer of material selected from a group consisting of silver and gold.

17. (Amended) A catheter as claimed in Claim 1 wherein a length of the outer wall of the catheter is at least partly formed from doped material able to act as a heat transfer device upon application of power therethrough.

18. (Amended) A catheter as claimed in Claim 17 wherein the doped material is selected from a group consisting of silver and gold.

19. (Amended) A catheter having a wall the catheter comprising at least one metal wire located in at least a portion of the wall.

20. (Amended) A catheter as claimed in Claim 19 wherein the at least one wire is copper.

21. (Amended) A catheter as claimed in Claim 19 wherein the at least one wire is co-extruded within the catheter body.

22. (Amended) A catheter as claimed in Claim 19 wherein the catheter wall includes at least one set of wires.

24. (Amended) A catheter as claimed in Claim 19 wherein each wire inside the catheter wall is easily exposable.

25. (Amended) A catheter as claimed in Claim 1 wherein the catheter wall has at least one metal wire located in at least a portion of the wall.

26. (Amended) A catheter as claimed in Claim 1 wherein the catheter has a diameter of between approximately size 3 to 5 F.

27. (Amended) A catheter as claimed in Claim 1 having a single distal lumen.

28. (Amended) A catheter as claimed in Claim 27 wherein the lumen has a diameter of between approximately 0.5 to 0.7 mm.

REMARKS

Claims 1-28 are currently pending. By means of this preliminary amendment, claims 1-6, 11-22, 24-28 have been amended to eliminate multiple dependencies and address some minor informalities. The changes are shown in the marked-up copy of the claims that follow this amendment. No new matter has been added to the application by means of these amendments.

It is respectfully submitted that the claims presented in this preliminary amendment are patentable over the art cited during international examination.

Applicants request early examination of the application on the merits.

If the Examiner believes that direct communication with the Applicants' attorney would advance the prosecution of this application, the Examiner is invited to telephone the undersigned at the number listed below.

Respectfully submitted,

NASHEF, AWS, ET AL.

BY: _____

ROBERT E. CANNUSCIO
Registration No. 36,469
Drinker Biddle & Reath LLP
One Logan Square
18th and Cherry Streets
Philadelphia, PA 19103-6996
Tel: 215-988-3303
Fax: 215-988-2757
Attorney for Applicants

Marked-Up Copy of Amended Claims

1. (Amended) A catheter having a distal end and a wall, the catheter comprising a heat transfer device located approximately at [or near] its distal end, wherein the heat transfer device is [layered or coated onto or into] engaged with the catheter wall.

2. (Amended) A catheter as claimed in Claim 1 wherein the heat transfer device is a flexible film having at least one [or more] electrical resistor flow path[s thereon or therethrough], which film is locatable around the catheter wall.

3. (Amended) A catheter as claimed in Claim 2 wherein the film is a flexible metal film on which the at least one [or more] electrical path[s have] has been [etched or otherwise created] formed.

4. (Amended) A catheter as claimed in Claim 2 wherein the at least one [or more] electrical path[s are] is located on [added onto] a plastic film backing.

5. (Amended) A catheter as claimed in Claim 4 wherein the at least one [or more] electrical path[s are] is added by a deposition process.

6. (Amended) A catheter as claimed in Claim 4 wherein the at least one [or] electrical path[s are] is added by a coating process.

11. (Amended) A catheter as claimed in Claim 10 wherein the printing process uses a conductive [ink or a conductive layer] medium, with subsequent etching.

12. (Amended) A catheter as claimed in [any one of Claims 7-11] Claim 7 wherein a temperature sensor material is also disposed onto the catheter wall by a deposition process.

13. (Amended) A catheter as claimed in [any one of the preceding Claims] Claim 1 wherein the heat transfer device includes at least one [or more temperature sensors or sensor leads] sensing element.

14. (Amended) A catheter as claimed [in any one of the preceding Claims] Claim 1 wherein at least one [or more] insulator layer[s are] is located over the resistor structure.

15. (Amended) A catheter as claimed in Claim 14 wherein the at least one [of the] insulator layer[s] is made from parylene C.

16. (Amended) A catheter as claimed in [any one of the preceding Claims] Claim 1 wherein the heat transfer device [comprises an outer or penultimate outer] an outwardly located layer of material selected from a group consisting of silver [or] and gold.

17. (Amended) A catheter as claimed in Claim 1 wherein a length of the outer wall of the catheter is at least [wholly, substantially or] partly formed from doped material able to act as a heat transfer device upon application of power therethrough.

18. (Amended) A catheter as claimed in Claim 17 wherein the doped material is selected from a group consisting of silver [or] and gold.

19. (Amended) A catheter having a wall [wherein the catheter wall has] the catheter comprising at least one [or more] metal wire[s] located in at least a portion of the wall [therethrough].

20. (Amended) A catheter as claimed in Claim 19 wherein the [or each] at least one wire is copper.

21. (Amended) A catheter as claimed in Claim 19 [or Claim 20] wherein the [or each] at least one wire is co-extruded within the catheter body.

22. (Amended) A catheter as claimed in [any one of Claims 19-21] Claim 19 wherein the catheter wall includes at least one [or more] set[s] of wires.

24. (Amended) A catheter as claimed in [any one of Claims 19-24] Claim 19 wherein [they or] each wire inside the catheter wall is easily exposable.

25. (Amended) A catheter as claimed in [any one of Claims 1-18] Claim 1 [in combination with a catheter as claimed in any one of Claims 19-24] wherein the catheter wall has at least one metal wire located in at least a portion of the wall.

26. (Amended) A catheter as claimed in [any one of the above Claims] Claim 1 wherein the catheter has a diameter of between approximately size 3 [-] to 5 F.

27. (Amended) A catheter as claimed in [any one of the preceding Claims] Claim 1 having a single distal lumen.

28. (Amended) A catheter as claimed in Claim 27 wherein the lumen has a diameter of between approximately [0.5-07] 0.5 to 0.7 mm.

"HEAT TRANSFER DEVICES"

The present invention relates to improvements for catheters having a heat transfer device at or near their distal end.

One of the present constraints concerning manufacture of catheters designed to monitor various cardiac output data is the manner and form of the required heat transfer device system. One present form of heat transfer device involves a thermal coil radially disposed about the catheter body to form a generally tubular coil which extends along the outside wall of the catheter. Such a heat transfer device is shown in US 5509424. However, such heat transfer coils require time and effort to wind and form and also restrict the possible miniaturisation of such catheters for use in paediatrics.

It is an object of the present invention to provide improvements to the manner and nature of heat transfer devices for use with catheters.

Thus, according to one aspect of the present invention, there is provided a catheter having a heat transfer device at or near its distal end, wherein the heat transfer device is layered or coated onto or into the catheter wall.

In one embodiment, the heat transfer device is a flexible film having one or more electrical resistor flow paths thereon or therethrough, which film is locatable around the catheter wall.

Such films can include flexible metal films on which one or more electrical paths have been etched or otherwise created. Alternatively, one or more electrical paths could be added onto a plastic film backing. The form of addition includes any type of deposition or coating, and the one or more electrical paths could be formed by etching, etc to form the resistor structure.

One or more temperature sensors or sensor leads could be included on or within the heat transfer device film to monitor the temperature of the electrical path(s), and thus the temperature of the overall heat transfer device.

Suitable backing materials include PVC, polyurethane, silk, synthetic silk, silicon rubber, Elaston™ etc, possibly about 20-80 microns thick, and suitable thin high resistant metal films include nickel, chromium or nickel-chromium. These can be deposited on the plastic backing material, and patterned using a photolithography mask to form the resistor structure.

On top of the resistor structure could be located a suitable insulator like parylene C, followed by deposition of a suitable temperature sensing means e.g. thermistors or platinum. Finally the outer surface may be coated with a silver or gold layer, possibly 5-10 microns thick. This layer assists in averaging heat distribution. Gold and/or silver are suitable as they are conductive and biocompatible. Optionally a further layer of parlyene C or other insulation is added as the outer layer.

Possible arrangements for the electrical paths and temperature sensing means across the backing material are shown in Figures 3 and 4 of the accompanying drawings.

This form of heat transfer device can be fixed around a catheter at or near its distal end. Preferably the film is about 0.5-2.0 cm long, in order for it to remain within the main pulmonary artery trunk. The film could be fixed around the catheter starting at about 4-5 cm from the tip, and in the case of a PVC

catheter body, the PVC film heat transfer device could be bonded by solvent.

Such a heat transfer device could be adapted to fit a catheter les than 7F diameter (2.3mm). More preferably the heat transfer device can be incorporated in a catheter of 3-5F (1-1.67mm) diameter. The heat transfer device should not increase the outer diameter of the catheter more than about 0.3F (0.1mm).

Using the same technique, a similar film could be formed purely for temperature sensing. The temperature sensing material could be deposited on a backing film, followed by parylene (and gold) coatings. Such a temperature sensor could be positioned to 2-4 cm proximal to the heat transfer device. Optionally a further layer of parlyene C or other insulation is added as the outer layer.

According to another embodiment of the present invention, the heat transfer device is disposed onto the catheter wall by any known method of deposition, eg plasma deposition, printing, electroplating onto plastic, photo lithography etc. Application by printing uses eg conductive ink, or a conductive layer, with subsequently etching. This method of deposition can use any suitable resistive material. In addition, the temperature sensor material could be similarly applied.

According to a second aspect of the present invention, there is provided a catheter having a length of its outer wall formed wholly, substantially or partly from doped material able to act as a heat transfer device upon application of power therethrough.

This form of heat transfer device could be formed as an inherent part of the catheter wall, rather than as a separate addition of a heat transfer device to the catheter. The catheter wall is sufficiently doped with a resistive material or ingredient able to pass electrical current therethrough, without affecting its other properties. Any conductive material could be suitable, eg silver, gold.

According to a third aspect of the present invention, there is provided a catheter wall having one or more metal wires therethrough.

By locating the electrical connections within the catheter body wall, separate lumens for electrical connections to its distal end within the catheter interior are no longer required. These wires can also provide the catheter with the desired or required stiffness.

The wire(s) can be formed from any suitable metal, eg copper. Preferably, each wire is co-extruded within the catheter body.

More preferably, there are one or more sets of electrical wires in the catheter wall, each set having the required number of wires for the desired operations.

In one embodiment of the present invention, the catheter body has three sets of wires, each set comprising two wires. One set of wires is for a heating element, and the other two sets are for each of two temperature sensing elements located on or along the catheter wall, or one set for measuring ambient blood temperature, and the other set for measuring the temperature of the heat transfer device, or any other suitable combination of measurements.

The wire or wires inside the catheter wall should be easily exposable and thus connectable to the required electrical units to which they correspond. Any exposed wire could be covered by a suitable insulator such as vinyl adhesive, or urethane potting compound.

An example of this aspect of the present invention is shown in Figure 2 of the accompanying drawings.

According to a preferred embodiment of the present invention, there is provided a catheter combining the first and third aspects described above.

One advantage of the use of one or more aspects of the present invention as described above is the

ability to reduce the size of the catheter, more particularly for paediatric use. A catheter wherein the electrical wires required for the heat transfer device, etc are co-extruded within the catheter body, means that the catheter may only need a single distal lumen, (possibly 0.5-0.7 mm diameter) for solution infusion and pressure monitoring.

The novel apparatus and methods of the present invention could also be used in non-medical fields using heat transfer devices at or near the distal ends of elongate tubing to be located in remote locations. Such fields include aeronautics, any fluid flow analysis, food and drink processing and monitoring, water and sewerage management, chemical engineering, fuel supply to engines, etc.

The present invention is also particularly applicable to the paediatric catheter field.

Embodiments of the present invention are shown by way of example only in the accompanying diagrammatic drawings in which:

Figure 1 is side view of a paediatric catheter;

Figure 2 is a radial cross-sectional view of a catheter wall having electrical wires located therein;

Figure 3 is an example of a heat transfer device film for application around a catheter body;

Figure 4 is an example of a temperature sensor for application around a catheter body.

Figure 5 is a longitudinal cross-sectional view of a catheter body having a heat transfer device therearound.

Figures 6a, b and c show a method of preparing a catheter having a heat transfer device.

The dimensions referred to in relation to accompanying diagrammatic drawings are illustrative only, and in no way limiting or essential.

Referring to the drawings, Figure 1 shows the general form of a paediatric pulmonary artery catheter, which may be 70-100 cm long. At one end, such catheters generally have a connection 2, for example, to a TRUCCOM™, and a distal lumen 4. Such catheters are generally 3-5F size, i.e. approximately 1-1.67mm diameter.

For all such catheters, the heat transfer device should preferably be in the range 0.5-2.0 cm long in order to remain within the main pulmonary artery trunk. The catheter body shore hardness should be about 45-55D for proper handling during insertion

into patients. Use of softer materials may be possible, but may require the additional use of a wire to stiffen the catheter body allowing manoeuvrability during insertion.

In the versions of the present invention based on the layering or coating of the transfer device onto or into the catheter wall, the heat transfer device should not increase the outer diameter of the catheter more than 0.3F (0.1mm).

Figure 1 shows a schematic representation of a heat transfer device 6 according to the present invention 2cm long, and located 4cm from the end of the catheter. Thereafter is located a temperature sensor 8, approximately 0.3cm long.

Figure 2 is a cross-section of a catheter wall 10 wherein six copper wires 12 are co-extruded with the catheter body so as to be located in the catheter wall 10. Of the six wires, two are located for the heating element, and two for each of two temperature sensing elements (not shown). Thus, the catheter only has a single distal lumen 14, 0.5mm diameter for solution infusion and pressure monitoring.

Figure 3 is an example of a flexible metal film heat transfer device 20 according to the present invention. The film consists of a thin high resistance metal film, e.g. of nickel, chromium or nickel-chromium, deposited on a PVC film 22, e.g. of

25-50 microns thick. The resistor wire 24 in Figure 3 can be patterned using a photolithography mask. The device 20 includes temperature sensor leads 26.

Figure 4 shows a possible pattern for temperature sensor leads 30 on a similar PVC film 32 to act as a temperature sensor as shown in Figure 1. It is similarly made to the device in Figure 3, but only the temperature sensing material is deposited followed by Paralyene C and gold coatings.

Figure 5 shows a longitudinal cross-section of a catheter having a heat transfer device 34 based on that shown in Figure 3. Around the catheter body 36 is a PVC film 0.05mm thick. The resistor and temperature sensor leads are on the PVC film, which is then coated with a suitable insulator such as Parylene C, possibly of 0.005mm thickness. The outer surface is coated with a silver or gold layer (suitably 5-10 microns thick).

As shown in Figures 6a-6c the overall heat transfer device 34 can be conjoined with the catheter body 36 using any suitable means such as a solvent. A temperature sensor 40 such as that shown in Figure 4 is also conjoined with the catheter body 36, e.g. 2-4 cm proximal to the device 34. Thereafter, and as shown in Figures 6a-c, the wires 38 inside the catheter wall 36 are then exposed and the heat and temperature sensing wires are then connected and

covered by a vinyl adhesive or another suitable insulator.

Claims

1. A catheter having a heat transfer device at or near its distal end, wherein the heat transfer device is layered or coated onto or into the catheter wall.

2. A catheter as claimed in Claim 1 wherein the heat transfer device is a flexible film having one or more electrical resistor flow paths thereon or therethrough, which film is locatable around the catheter wall.

3. A catheter as claimed in Claim 2 wherein the film is a flexible metal film on which the one or more electrical paths have been etched or otherwise created.

4. A catheter as claimed in Claim 2 wherein the one or more electrical paths are added onto a plastic film backing.

5. A catheter as claimed in Claim 4 wherein the one or more electrical paths are added by a deposition process.

6. A catheter as claimed in Claim 4 wherein the one or electrical paths are added by a coating process.

7. A catheter as claimed in Claim 1 wherein the heat transfer device is disposed directly onto the catheter wall.

8. A catheter as claimed in Claim 7 wherein the heat transfer device is disposed onto the catheter wall by a deposition process.

9. A catheter as claimed in Claim 8 where in the deposition process is a plasma deposition process.

10. A catheter as claimed in Claim 8 wherein the deposition process is a printing process.

11. A catheter as claimed in Claim 10 wherein the printing process uses a conductive ink or a conductive layer, with subsequent etching.

12. A catheter as claimed in any one of Claims 7-11 wherein a temperature sensor material is also disposed onto the catheter wall by a deposition process.

13. A catheter as claimed in any one of the preceding Claims wherein the heat transfer device includes one or more temperature sensors or sensor leads.

14. A catheter as claimed in any one of the preceding Claims wherein one or more insulator layers are located over the resistor structure.

15. A catheter as claimed in Claim 14 wherein one of the insulator layers is parylene C.

16. A catheter as claimed in any one of the preceding Claims wherein the heat transfer device comprises an outer or penultimate outer layer of silver or gold.

17. A catheter as claimed in Claim 1 wherein a length of the outer wall of the catheter is wholly, substantially or partly formed from doped material able to act as a heat transfer device upon application of power therethrough.

18. A catheter as claimed in Claim 17 wherein the doped material is silver or gold.

19. A catheter wherein the catheter wall has one or more metal wires therethrough.

20. A catheter as claimed in Claim 19 wherein the or each wire is copper.

21. A catheter as claimed in Claim 19 or Claim 20 wherein the or each wire is co-extruded within the catheter body.

22. A catheter as claimed in any one of Claims 19-21 wherein the catheter wall includes one or more sets of wires.

23. A catheter as claimed in Claim 22 wherein the catheter body has three sets of wires, each set comprising two wires.

24. A catheter as claimed in any one of Claims 19-24 wherein they or each wire inside the catheter wall is easily exposable.

25. A catheter as claimed in any one of Claims 1-18 in combination with a catheter as claimed in any one of Claims 19-24.

26. A catheter as claimed in any one of the above Claims of size 3-5F.

27. A catheter as claimed in any one of the preceding Claims having a single distal lumen.

28. A catheter as claimed in Claim 27 wherein the lumen has a diameter of approximately 0.5-07 mm.

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(71) Applicant *(for all designated States except US)*: **AORTECH INTERNATIONAL PLC** [GB/GB]; Phoenix Crescent, Strathclyde Business Park, Bellshill ML4 3NJ (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **NASHEF, Aws** [US/GB]; 1 Langside Crescent, Bothwell, Glasgow G71 8DG (GB). **WIEDE, Ted, Vander** [US/GB]; 5 Flemington Court, Strathaven M40 6FL (GB). **MCNAIR, Robert** [GB/GB]; Flat 2/1, 93 Stranmore Road, Mount Florida, Glasgow G42 9AL (GB). **WILSON, Stephen** [GB/GB]; 63 Drum Crescent, Gilmorton, Edinburgh EH17 7EB (GB). **ANDREWS, Simon** [GB/GB]; 24 Louden Hill Road, Robroyston, Glasgow G33 1GA (GB).

(74) Agent: **MURGITROYD & COMPANY**; 373 Scotland Street, Glasgow G5 8QA (GB).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

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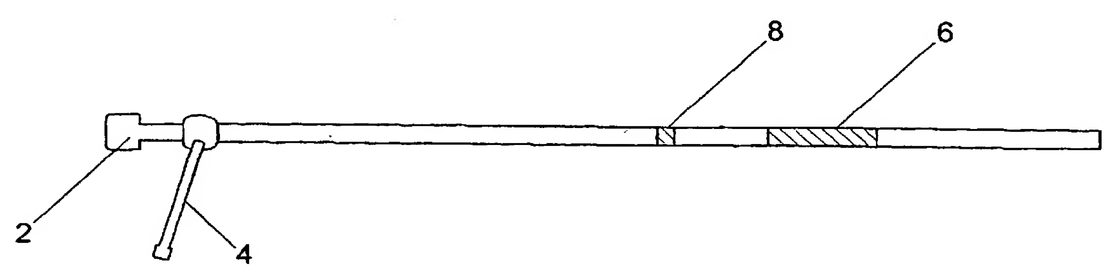
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: HEAT TRANSFER DEVICES



(57) Abstract: A catheter having a heat transfer device at or near its distal end, wherein the heat transfer device is layered or coated onto or into the catheter wall is described. The heat transfer device is preferably a flexible film having one or more electrical resistor flow paths thereon or therethrough, or is disposed directly onto the catheter wall by a deposition process. The heat transfer device may alternatively be formed by a length of the catheter wall being formed wholly, substantially of partly from doped material able to act as a heat transfer device upon application of power therethrough. The heat transfer device is preferably powered by one or more metal wires co-extruded within the catheter body.

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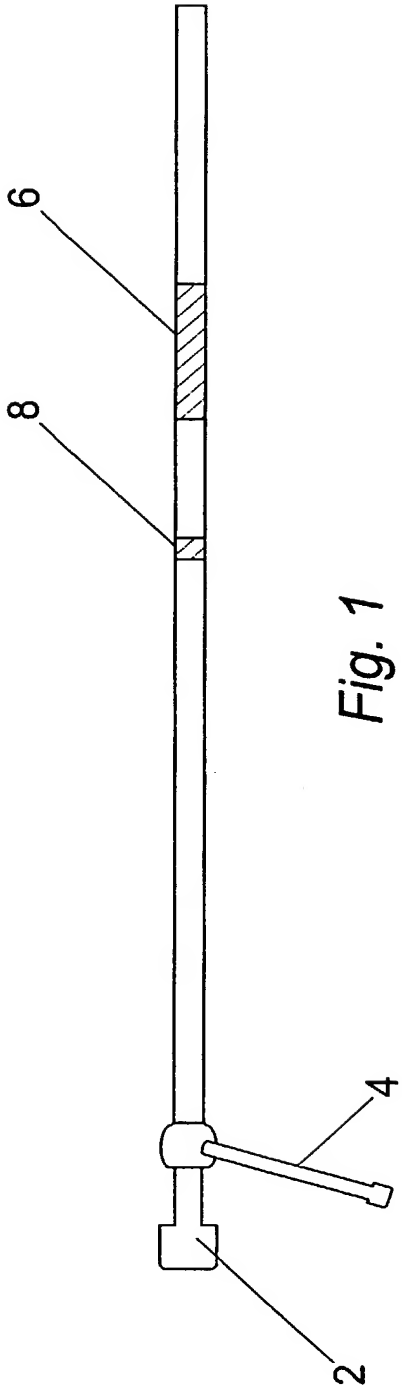

Fig. 1

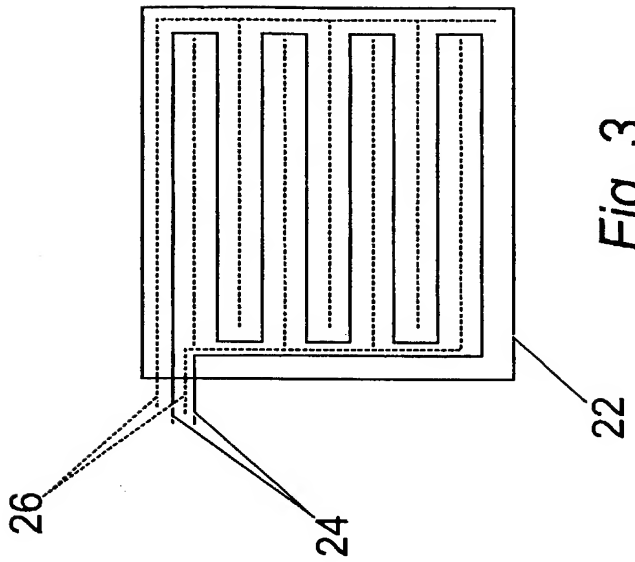

Fig. 3

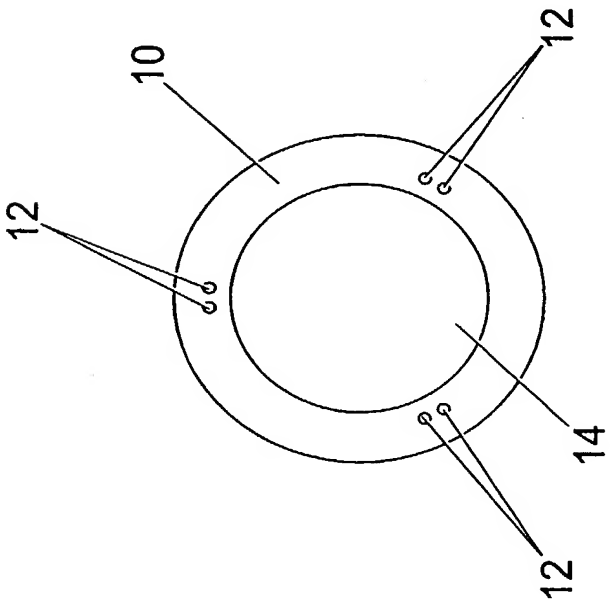

Fig. 2

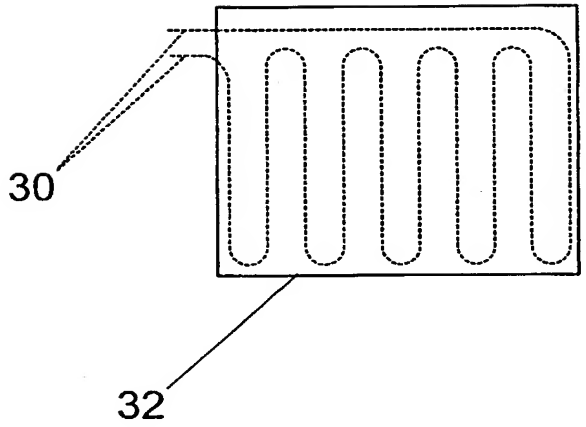

Fig. 4

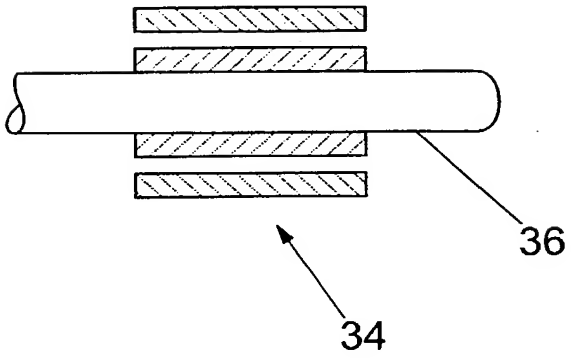

Fig. 5

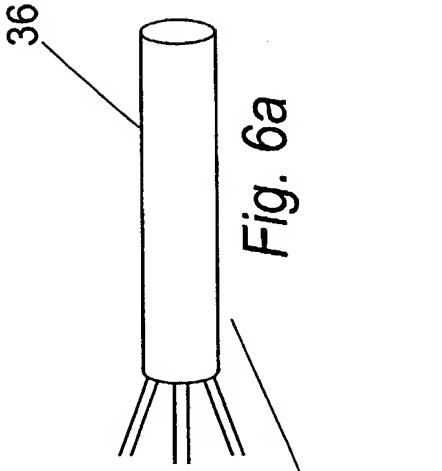

Fig. 6a

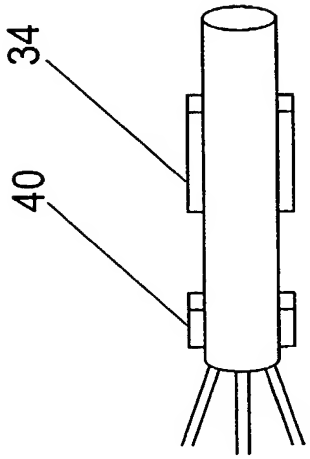

Fig. 6b

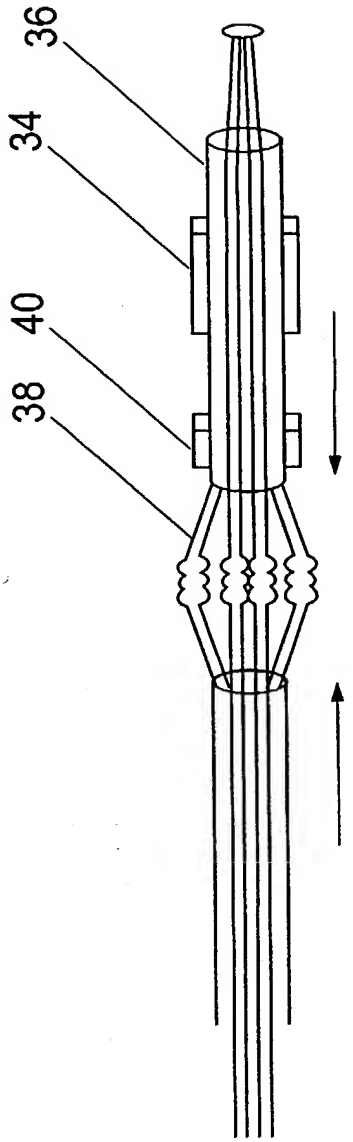

Fig. 6c

PATENT
Attorney Docket No. 8830-27

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are stated below next to my name:

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

HEAT TRANSFER DEVICES

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the specification of which was filed on August 25, 2000 as PCT Application No. PCT/GB00/03273 and amended on February 26, 2002 (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with 37 CFR §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT international application which designated at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S)

COUNTRY/OFFICE	APPLICATION NO.	DATE OF FILING	PRIORITY CLAIMED
United Kingdom	9920112.1	August 26, 1999	☒YES NO ☐

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

PROVISIONAL APPLICATION NUMBER	DATE OF FILING
60/153,414	September 10, 1999

I hereby claim the benefit under 35 U.S.C. §120 of any United States application(s) or §365(c) of any PCT International application(s) designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose material information as defined in 37 CFR §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. §120

		Status (check one)		
Application Serial No.	**Date of Filing**	**Patented**	**Pending**	**Abandoned**
NONE		☐	☐	☐

8

And I hereby appoint Arthur H. Seidel, Registration No. 15,979; Gregory J. Lavorgna, Registration No. 30,469; Daniel A. Monaco, Registration No. 30,480; Thomas J. Durling, Registration No. 31,349; John J. Marshall, Registration No. 29,671; Joseph R. DelMaster, Jr., Registration No. 38,123; Robert E. Cannuscio, Registration No. 36,469; and George A. Frank, Registration No. 27,636, my attorneys or agents with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

Address all correspondence to **Robert E. Cannuscio**, Drinker Biddle & Reath LLP, One Logan Square, 18th and Cherry Streets, Philadelphia, Pennsylvania 19103-6996. Address all telephone calls to **Robert E. Cannuscio** at 215-988-3303 (telefax: 215-988-2757).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

1-00

FULL NAME OF FIRST INVENTOR

AWS		**NASHEF**
(GIVEN NAME)	*(MIDDLE INITIAL OR NAME)*	*(FAMILY OR LAST NAME)*

Inventor's signature: [signature]

Date: 13-06-02

Country of Citizenship: United States

Residence: Glasgow — Great Britain GBN
(City) — *(State or Foreign Country)*

Post Office Address:
1 Langside ~~Cresent~~ Court
Bothwell, Glasgow
G71 8~~DG,~~ NS GREAT BRITAIN

2-00

FULL NAME OF SECOND INVENTOR

TED	~~**VANDER**~~ F	VANDER **WIEDE**
(GIVEN NAME)	*(MIDDLE INITIAL OR NAME)*	*(FAMILY OR LAST NAME)*

Inventor's signature: [signature]

Date: 9 Sept 2002

Country of Citizenship: United States

Residence: Strathaven — Great Britain GBX
(City) — *(State or Foreign Country)*

Post Office Address:
12 Wellbrae
~~5 Flemington Court~~
~~Strathaven~~ Stonehouse
~~M40 6FL~~, GREAT BRITAIN
ML9 3EQ

3.00

FULL NAME OF THIRD INVENTOR

ROBERT (GIVEN NAME) (MIDDLE INITIAL OR NAME) **MACNAIR** (FAMILY OR LAST NAME)

Inventor's signature: Robert Macnair

Date: 13TH JUNE 2002

Country of Citizenship: Great Britain

Residence: Glasgow (City) Great Britain GBN (State or Foreign Country)

Post Office Address: Flat 2/1, 93 Stranmore Road
Mount Florida, Glasgow
G42 9AL, GREAT BRITAIN

4.00

FULL NAME OF FOURTH INVENTOR

STEPHEN (GIVEN NAME) (MIDDLE INITIAL OR NAME) **WILSON** (FAMILY OR LAST NAME)

Inventor's signature: Stephen Wilson

Date: 13/6/02

Country of Citizenship: Great Britain

Residence: Edinburgh (City) Great Britain GBN (State or Foreign Country)

Post Office Address: 63 Drum Cresent
Gilmorton, Edinburgh
EH17 7EB, GREAT BRITAIN

5.00

FULL NAME OF FIFTH INVENTOR

SIMON	—	ANDREWS
(GIVEN NAME)	*(MIDDLE INITIAL OR NAME)*	*(FAMILY OR LAST NAME)*

Inventor's signature: _____

Date: 12/6/02

Country of Citizenship: Great Britain

Residence: Glasgow *(City)* Great Britain *(State or Foreign Country)* GBN

Post Office Address: 24 Louden Hill Road
Robroyston, Glasgow
G33 1GA, GREAT BRITAIN